US005884144A

United States Patent [19]

Chavez, Jr. et al.

[11] **Patent Number: 5,884,144**

[45] **Date of Patent: *Mar. 16, 1999**

[54] **MAINTENANCE AND ADMINISTRATION OF REMOTE SYSTEMS VIA RADIO PAGER**

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[73] Assignee: **Lucent Technologies Inc.**, Murray Hill, N.J.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **534,607**

[22] Filed: **Sep. 27, 1995**

[51] **Int. Cl.**[6] **H04Q 7/08**; H04Q 7/10; H04Q 7/12

[52] **U.S. Cl.** **455/31.3**; 455/31.2; 455/554; 455/560

[58] **Field of Search** 379/57, 58, 56; 340/825.44, 825, 311; 455/424, 560, 554, 31.3, 31.2

[56] **References Cited**

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Primary Examiner—Wellington Chin
Assistant Examiner—Keith Ferguson
Attorney, Agent, or Firm—John C. Moran

[57] **ABSTRACT**

An integral radio pager within each remote switch of a switching system with all pagers in the remote switches sharing the same paging service number with respect to a public paging service. When a central processor that is controlling the operation of all remote switches performs a maintenance restart operation with respect to one of the remote switches, the central processor requests that the public paging service page the common service number. The central processor also provides the paging service a paging message that defines which remote switch is to respond to the page. Each integral pager is responsive to the page to interrupt an associated remote processor. In turn, each remote processor is responsive to the pager to examine the paging message and only responds if the remote processor finds its own identification number in the paging message. In addition, the remote switches can each have an integral cellular telephone circuit that share a common telephone number thereby reducing the cost of providing the cellular telephone service. When the central processor wants to establish a data communication link with the remote switch via a cellular telephone call, the central processor requests that the public paging service page the common service number and provides a paging message to the public paging service. The paging message defines the identification number of the remote switch that is to respond to the page. A remote processor is responsive to the paging message to set up a data call via the integral cellular circuit to the central processor.

16 Claims, 9 Drawing Sheets

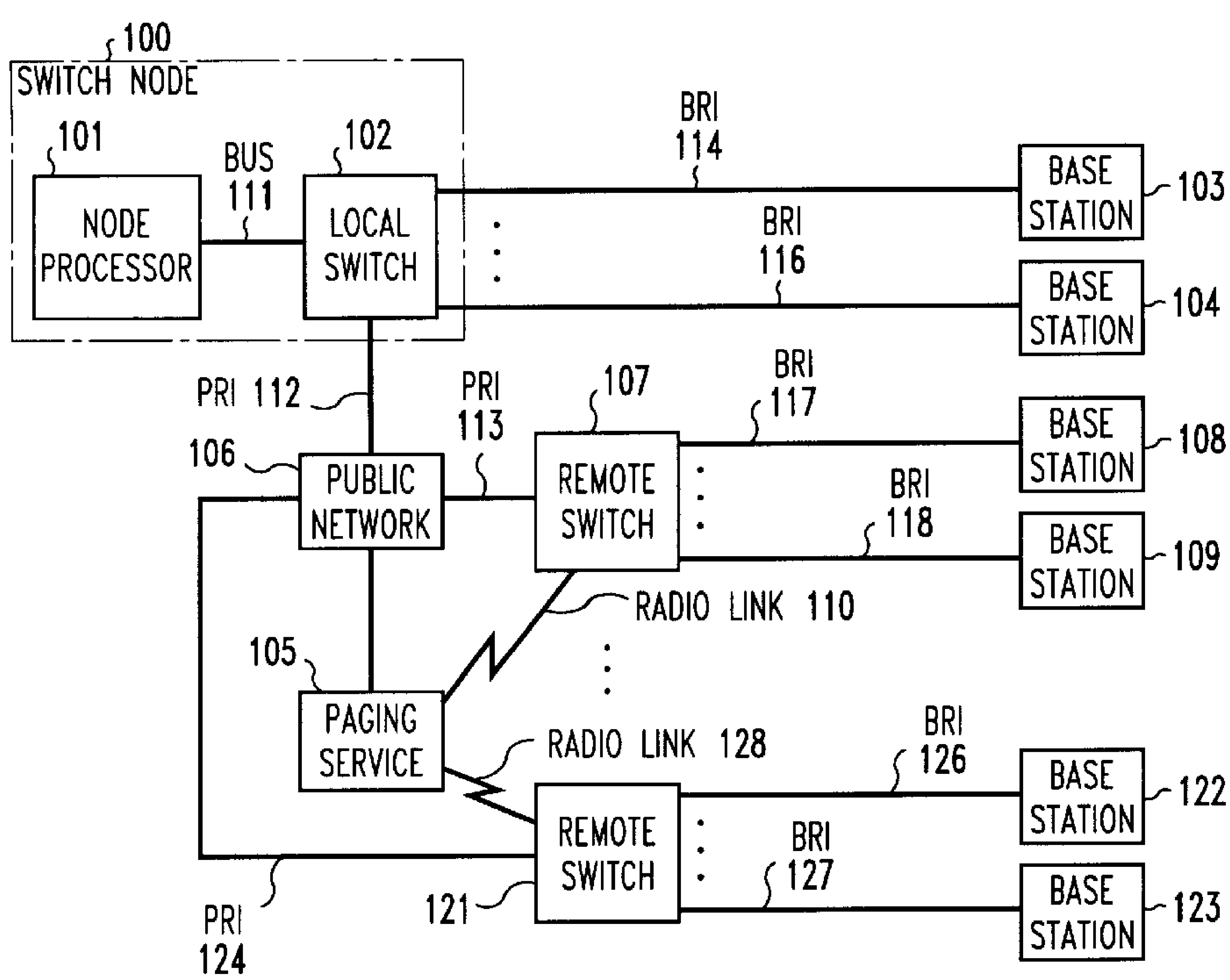


FIG. 1

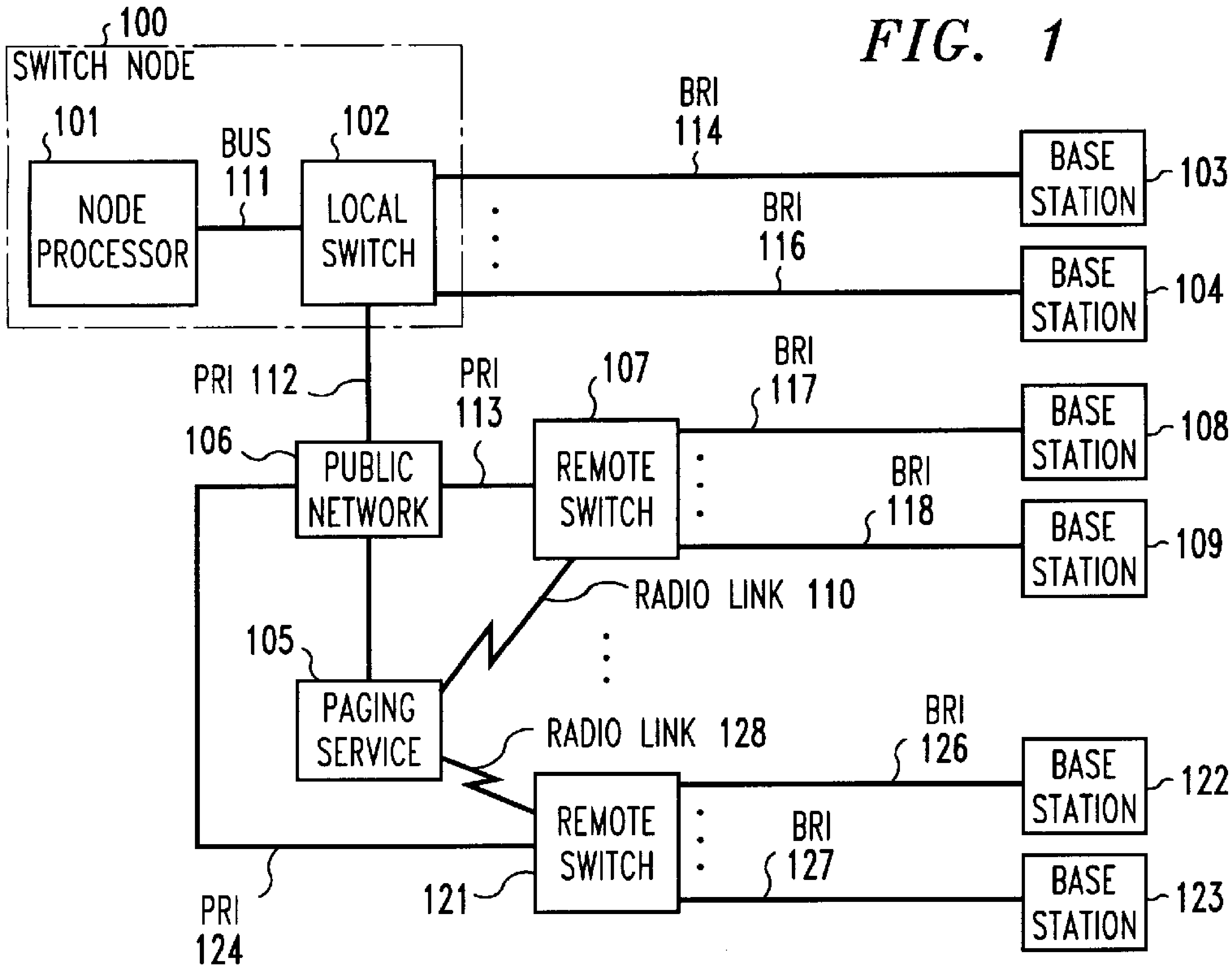


FIG. 2

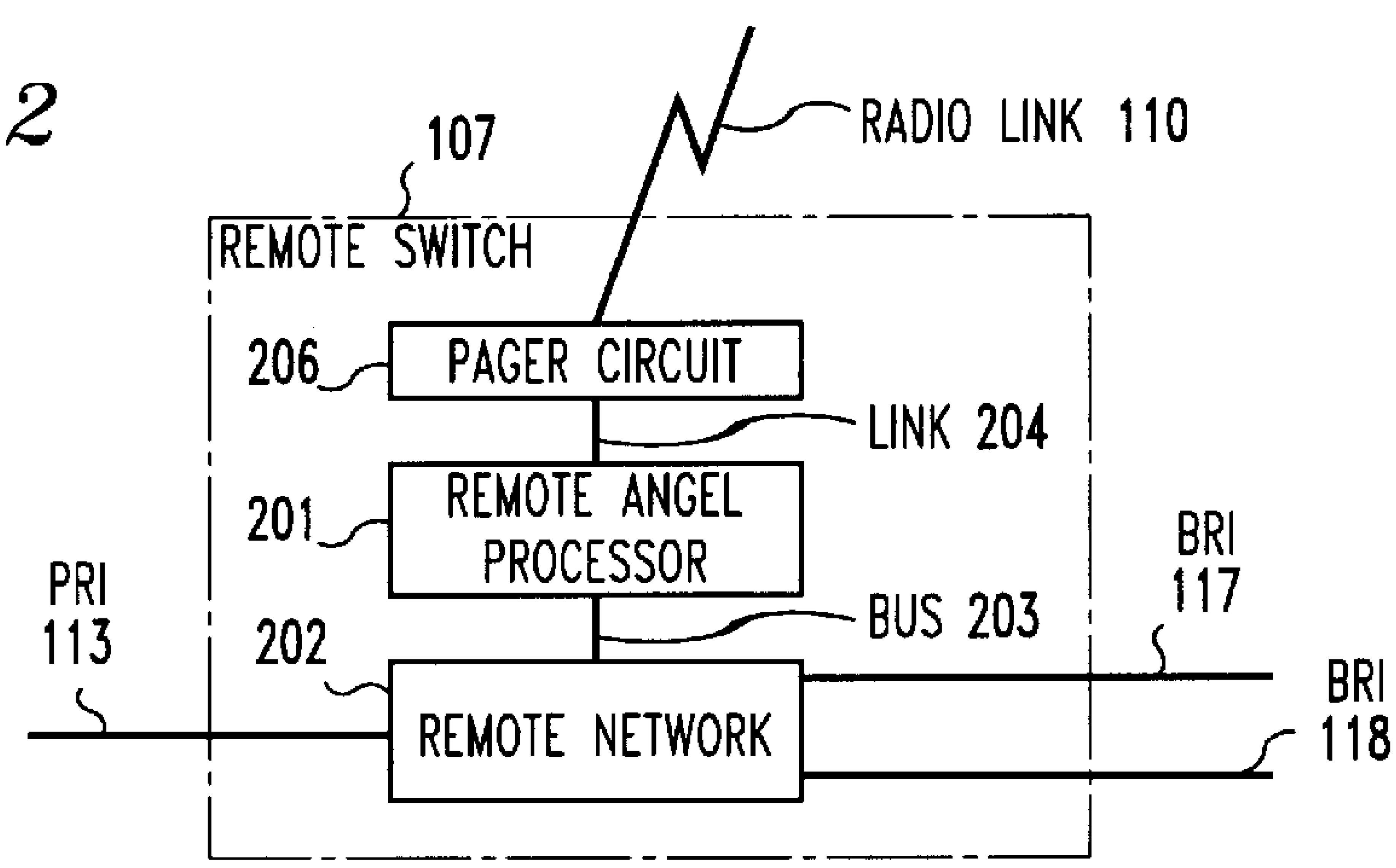


FIG. 3

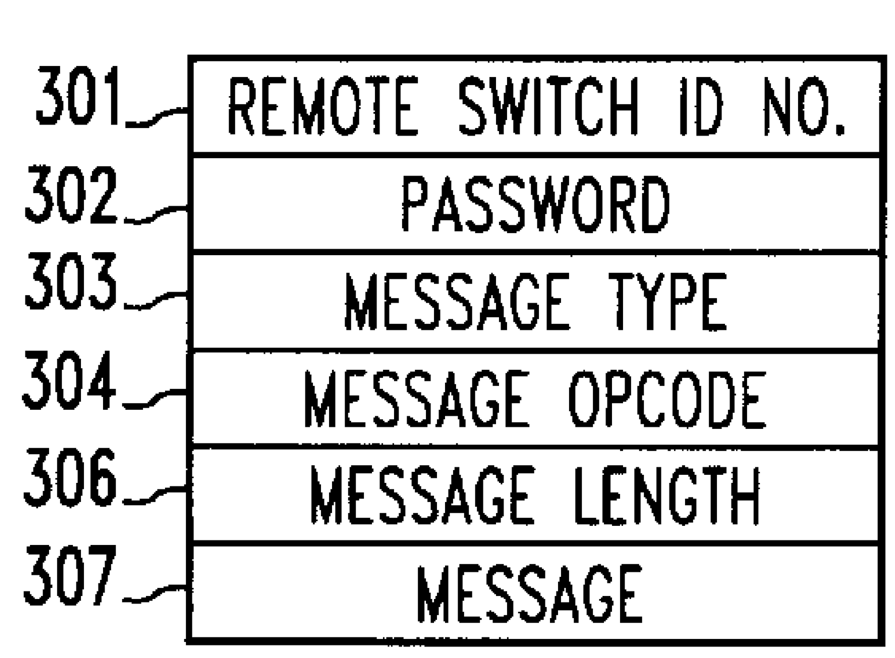


FIG. 4

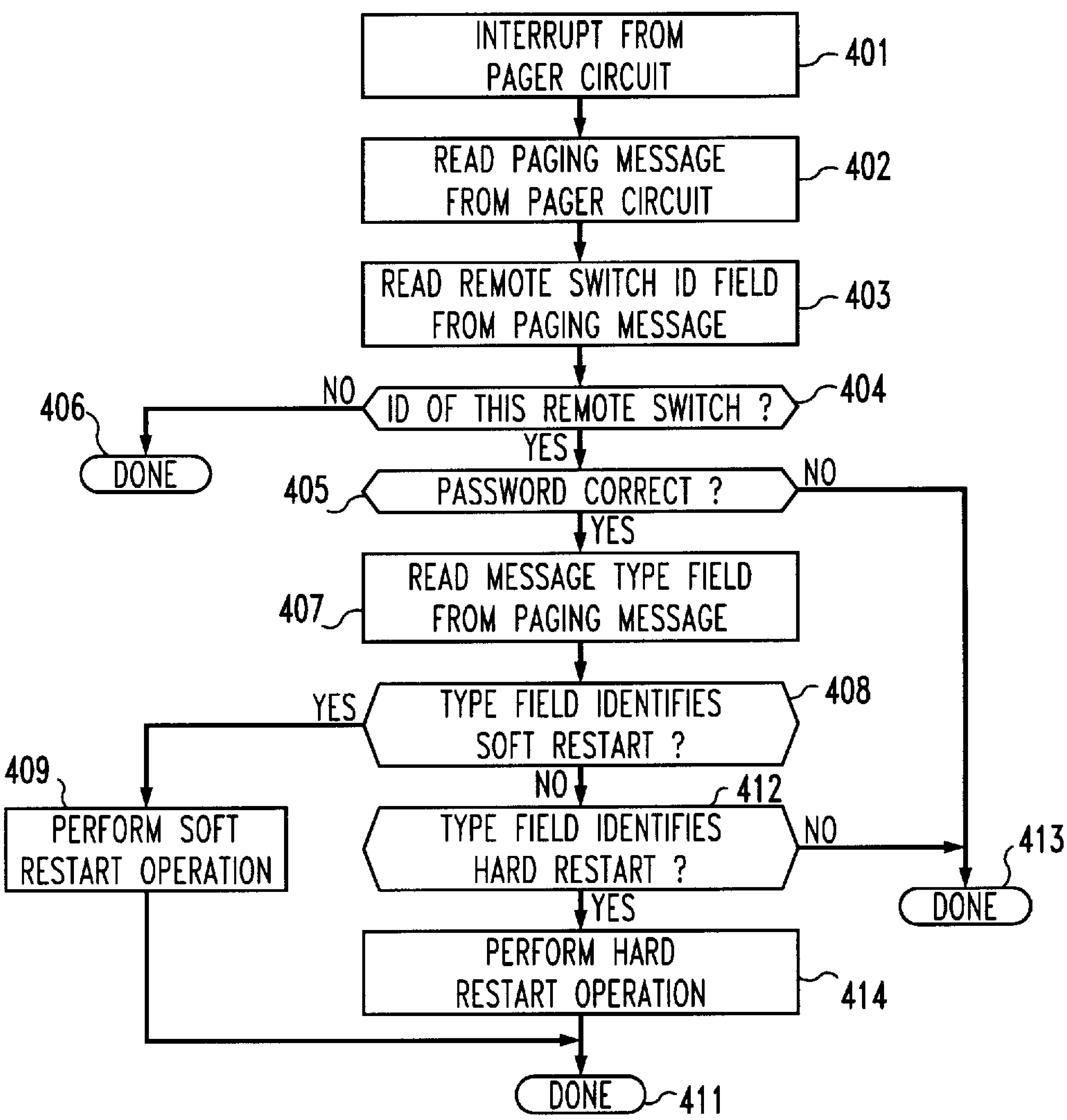

INTERRUPT FROM PAGER CIRCUIT
401
READ PAGING MESSAGE FROM PAGER CIRCUIT
402
READ REMOTE SWITCH ID FIELD FROM PAGING MESSAGE
403
ID OF THIS REMOTE SWITCH ?
404
NO
406
DONE
YES
405
PASSWORD CORRECT ?
NO
YES
407
READ MESSAGE TYPE FIELD FROM PAGING MESSAGE
TYPE FIELD IDENTIFIES SOFT RESTART ?
408
YES
409
PERFORM SOFT RESTART OPERATION
NO
412
TYPE FIELD IDENTIFIES HARD RESTART ?
NO
413
DONE
YES
PERFORM HARD RESTART OPERATION
414
DONE
411

FIG. 5

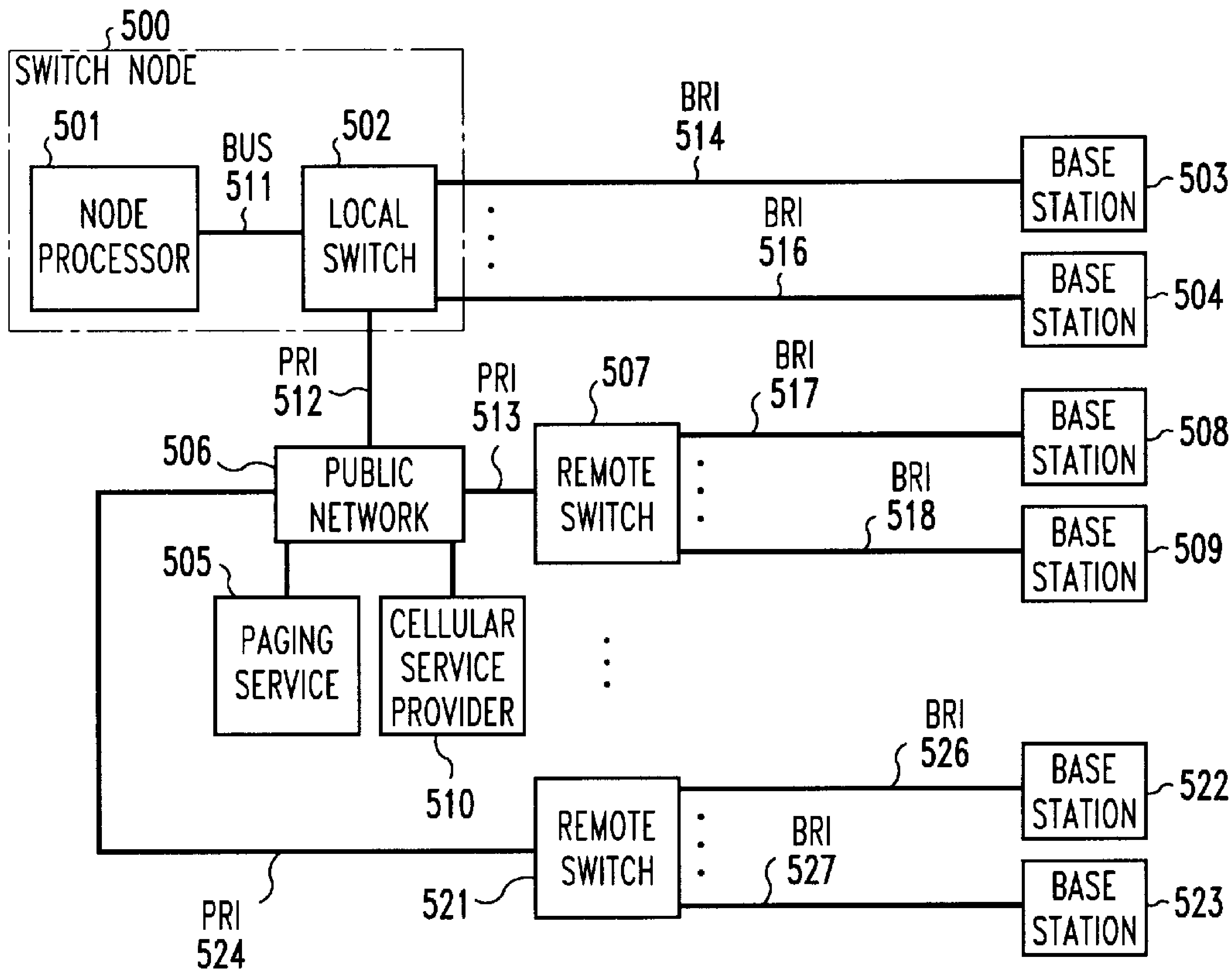

500
SWITCH NODE
501
NODE PROCESSOR
BUS 511
502
LOCAL SWITCH
BRI 514
BRI 516
BASE STATION
503
BASE STATION
504
PRI 512
PRI 513
507
BRI 517
506
PUBLIC NETWORK
REMOTE SWITCH
BRI 518
BASE STATION
508
BASE STATION
509
505
PAGING SERVICE
CELLULAR SERVICE PROVIDER
510
BRI 526
REMOTE SWITCH
BRI 527
BASE STATION
522
BASE STATION
523
PRI 524
521

FIG. 6

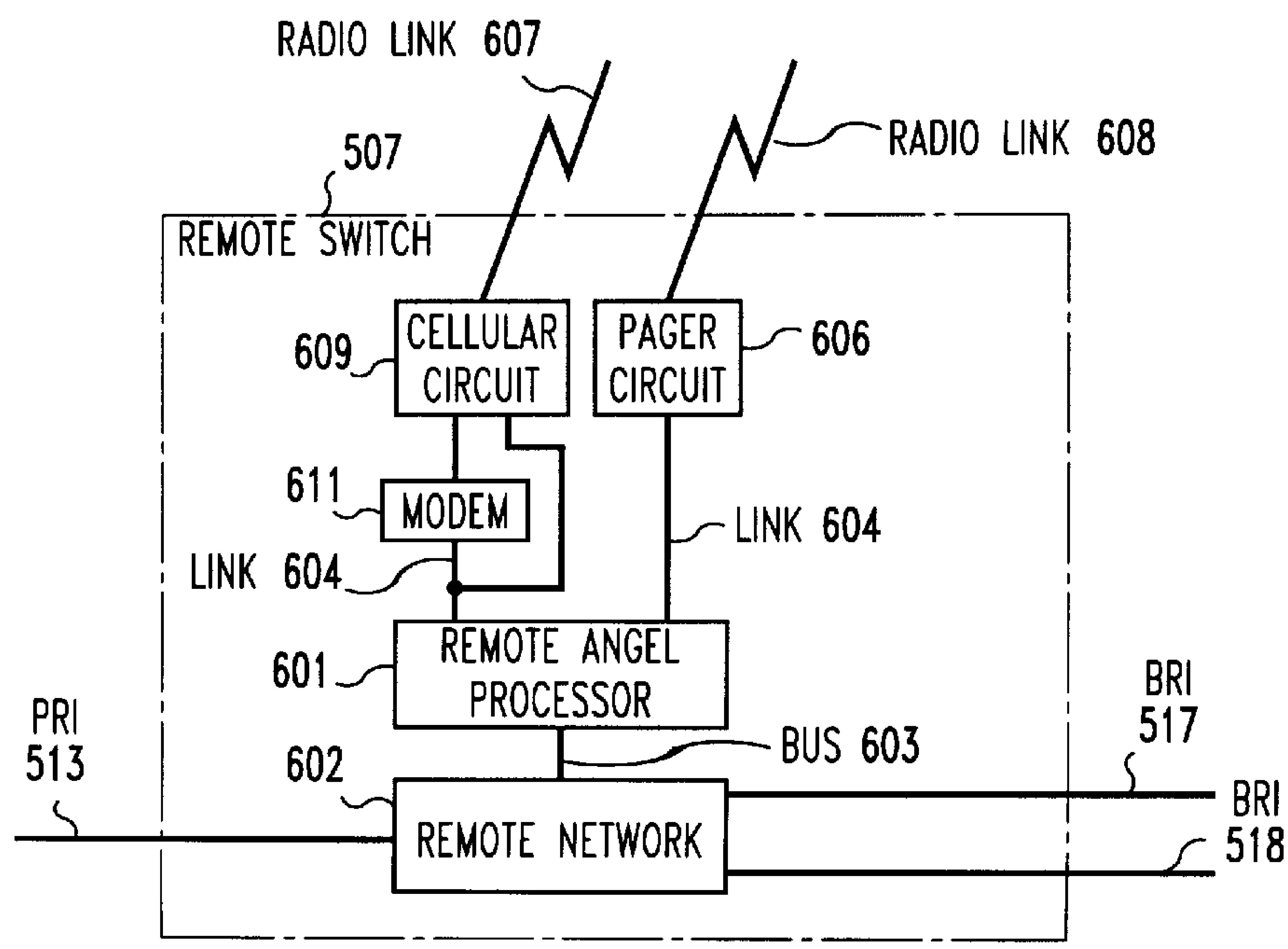

RADIO LINK 607
RADIO LINK 608
507
REMOTE SWITCH
609
CELLULAR CIRCUIT
PAGER CIRCUIT
606
611
MODEM
LINK 604
LINK 604
601
REMOTE ANGEL PROCESSOR
BUS 603
PRI 513
602
REMOTE NETWORK
BRI 517
BRI 518

FIG. 7

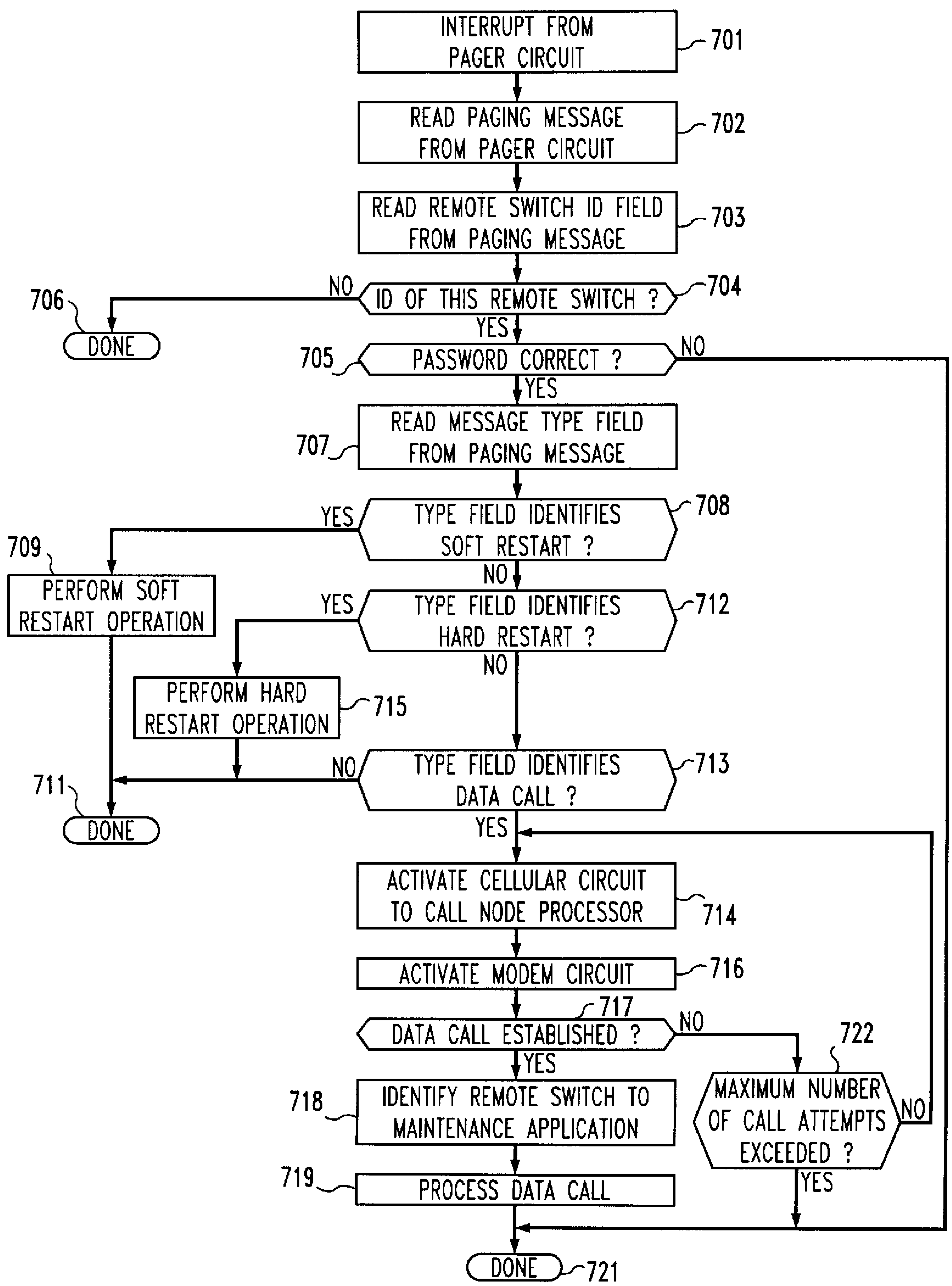

INTERRUPT FROM PAGER CIRCUIT
701
READ PAGING MESSAGE FROM PAGER CIRCUIT
702
READ REMOTE SWITCH ID FIELD FROM PAGING MESSAGE
703
ID OF THIS REMOTE SWITCH ?
704
NO
706
DONE
YES
705
PASSWORD CORRECT ?
NO
YES
707
READ MESSAGE TYPE FIELD FROM PAGING MESSAGE
708
TYPE FIELD IDENTIFIES SOFT RESTART ?
YES
709
PERFORM SOFT RESTART OPERATION
NO
TYPE FIELD IDENTIFIES HARD RESTART ?
712
YES
PERFORM HARD RESTART OPERATION
715
NO
TYPE FIELD IDENTIFIES DATA CALL ?
713
NO
711
DONE
YES
ACTIVATE CELLULAR CIRCUIT TO CALL NODE PROCESSOR
714
ACTIVATE MODEM CIRCUIT
716
717
DATA CALL ESTABLISHED ?
NO
722
YES
MAXIMUM NUMBER OF CALL ATTEMPTS EXCEEDED ?
NO
YES
718
IDENTIFY REMOTE SWITCH TO MAINTENANCE APPLICATION
719
PROCESS DATA CALL
DONE
721

FIG. 8

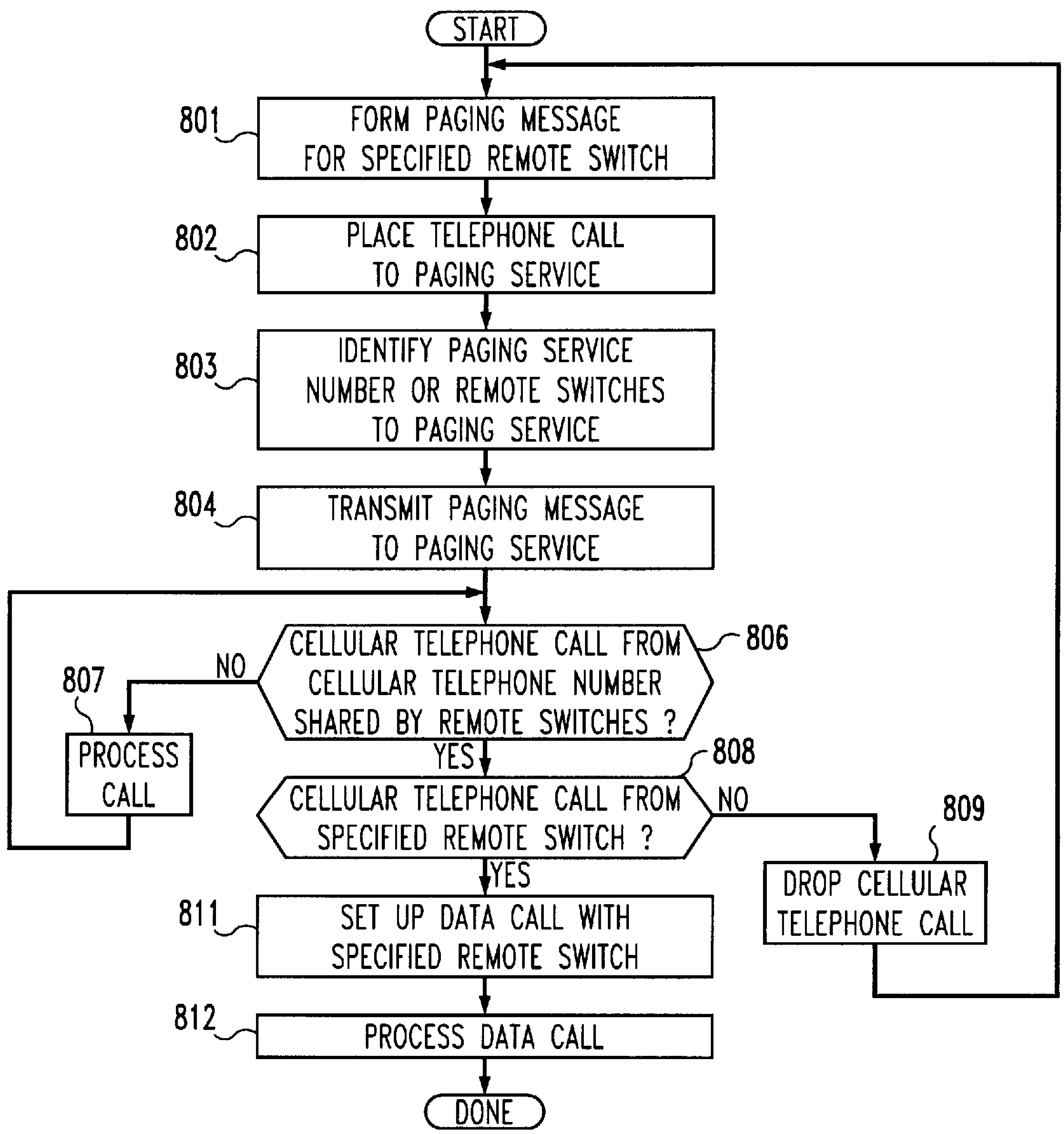

START
801
FORM PAGING MESSAGE FOR SPECIFIED REMOTE SWITCH
802
PLACE TELEPHONE CALL TO PAGING SERVICE
803
IDENTIFY PAGING SERVICE NUMBER OR REMOTE SWITCHES TO PAGING SERVICE
804
TRANSMIT PAGING MESSAGE TO PAGING SERVICE
806
CELLULAR TELEPHONE CALL FROM CELLULAR TELEPHONE NUMBER SHARED BY REMOTE SWITCHES ?
NO
807
PROCESS CALL
YES
808
CELLULAR TELEPHONE CALL FROM SPECIFIED REMOTE SWITCH ?
NO
809
DROP CELLULAR TELEPHONE CALL
YES
811
SET UP DATA CALL WITH SPECIFIED REMOTE SWITCH
812
PROCESS DATA CALL
DONE

FIG. 9

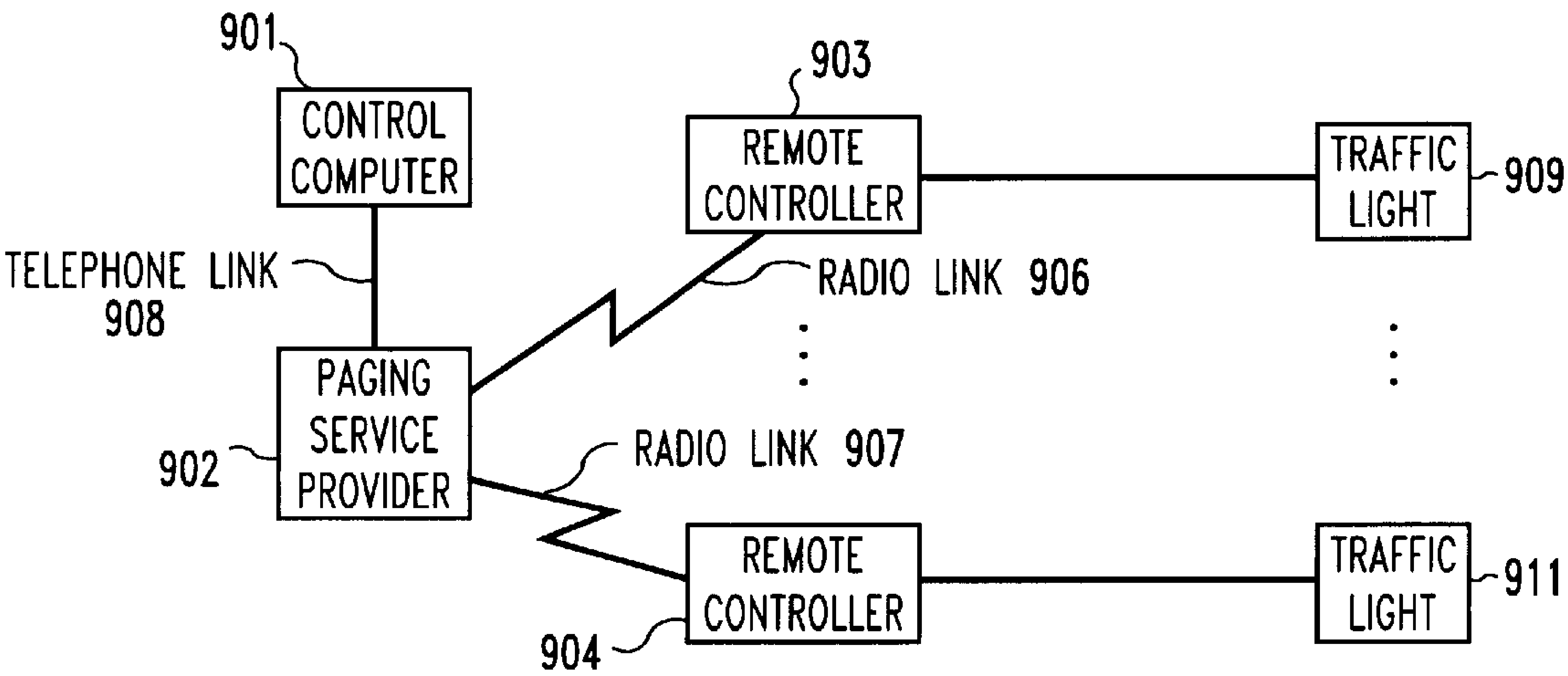

901
CONTROL COMPUTER
TELEPHONE LINK 908
PAGING SERVICE PROVIDER
902
903
REMOTE CONTROLLER
RADIO LINK 906
RADIO LINK 907
REMOTE CONTROLLER
904
TRAFFIC LIGHT
909
TRAFFIC LIGHT
911

FIG. 10

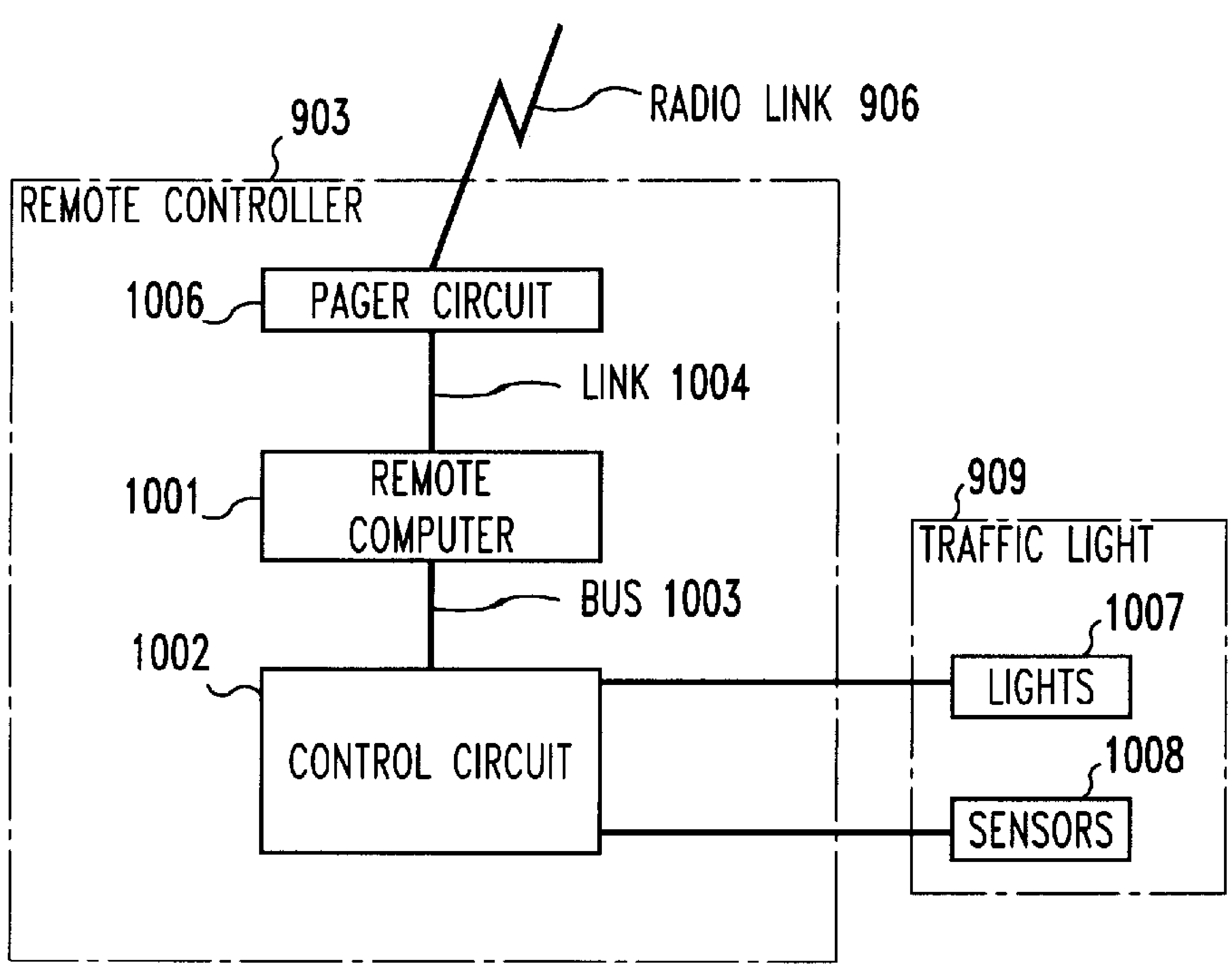

RADIO LINK 906
903
REMOTE CONTROLLER
1006
PAGER CIRCUIT
LINK 1004
1001
REMOTE COMPUTER
BUS 1003
1002
CONTROL CIRCUIT
909
TRAFFIC LIGHT
1007
LIGHTS
1008
SENSORS

FIG. 11

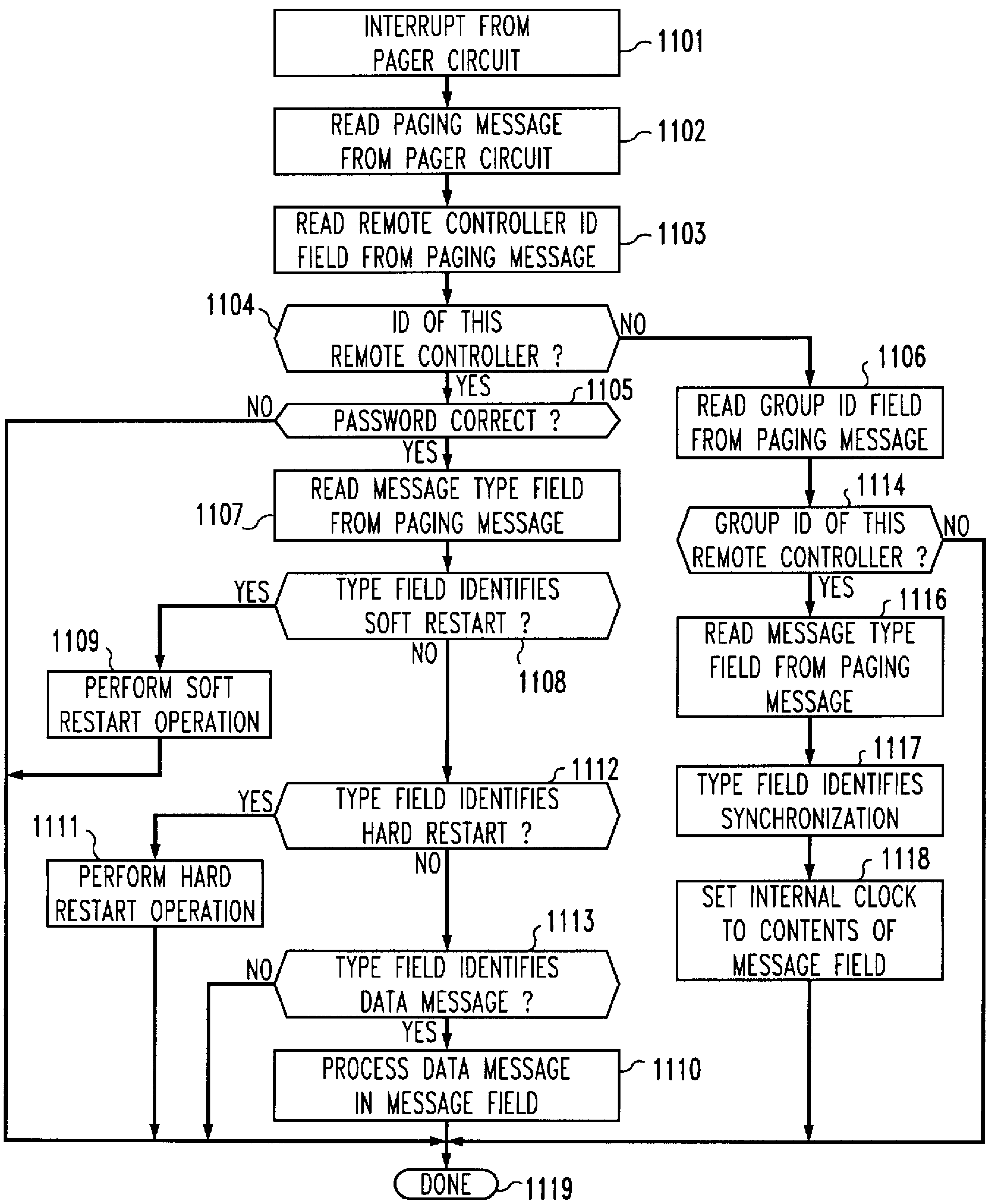

INTERRUPT FROM PAGER CIRCUIT
1101
READ PAGING MESSAGE FROM PAGER CIRCUIT
1102
READ REMOTE CONTROLLER ID FIELD FROM PAGING MESSAGE
1103
1104
ID OF THIS REMOTE CONTROLLER ?
NO
1106
READ GROUP ID FIELD FROM PAGING MESSAGE
YES
1105
NO
PASSWORD CORRECT ?
YES
READ MESSAGE TYPE FIELD FROM PAGING MESSAGE
1107
1114
GROUP ID OF THIS REMOTE CONTROLLER ?
NO
YES
1116
READ MESSAGE TYPE FIELD FROM PAGING MESSAGE
YES
TYPE FIELD IDENTIFIES SOFT RESTART ?
NO
1108
1109
PERFORM SOFT RESTART OPERATION
1117
TYPE FIELD IDENTIFIES SYNCHRONIZATION
1112
YES
TYPE FIELD IDENTIFIES HARD RESTART ?
NO
1111
PERFORM HARD RESTART OPERATION
1118
SET INTERNAL CLOCK TO CONTENTS OF MESSAGE FIELD
1113
NO
TYPE FIELD IDENTIFIES DATA MESSAGE ?
YES
PROCESS DATA MESSAGE IN MESSAGE FIELD
1110
DONE
1119

FIG. 12

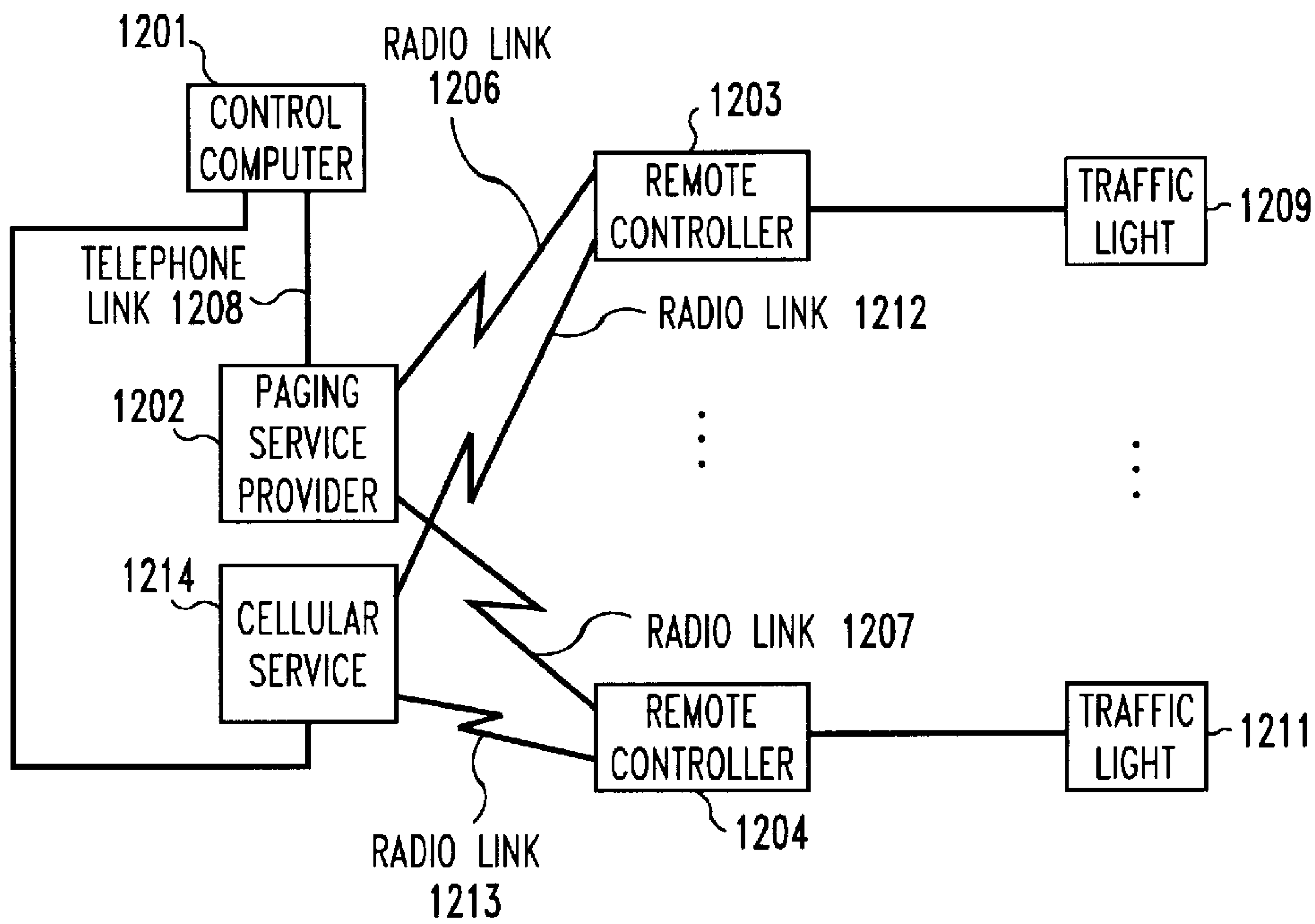

1201
CONTROL COMPUTER
RADIO LINK 1206
1203
REMOTE CONTROLLER
TRAFFIC LIGHT
1209
TELEPHONE LINK 1208
RADIO LINK 1212
1202
PAGING SERVICE PROVIDER
1214
CELLULAR SERVICE
RADIO LINK 1207
REMOTE CONTROLLER
TRAFFIC LIGHT
1211
1204
RADIO LINK 1213

FIG. 13

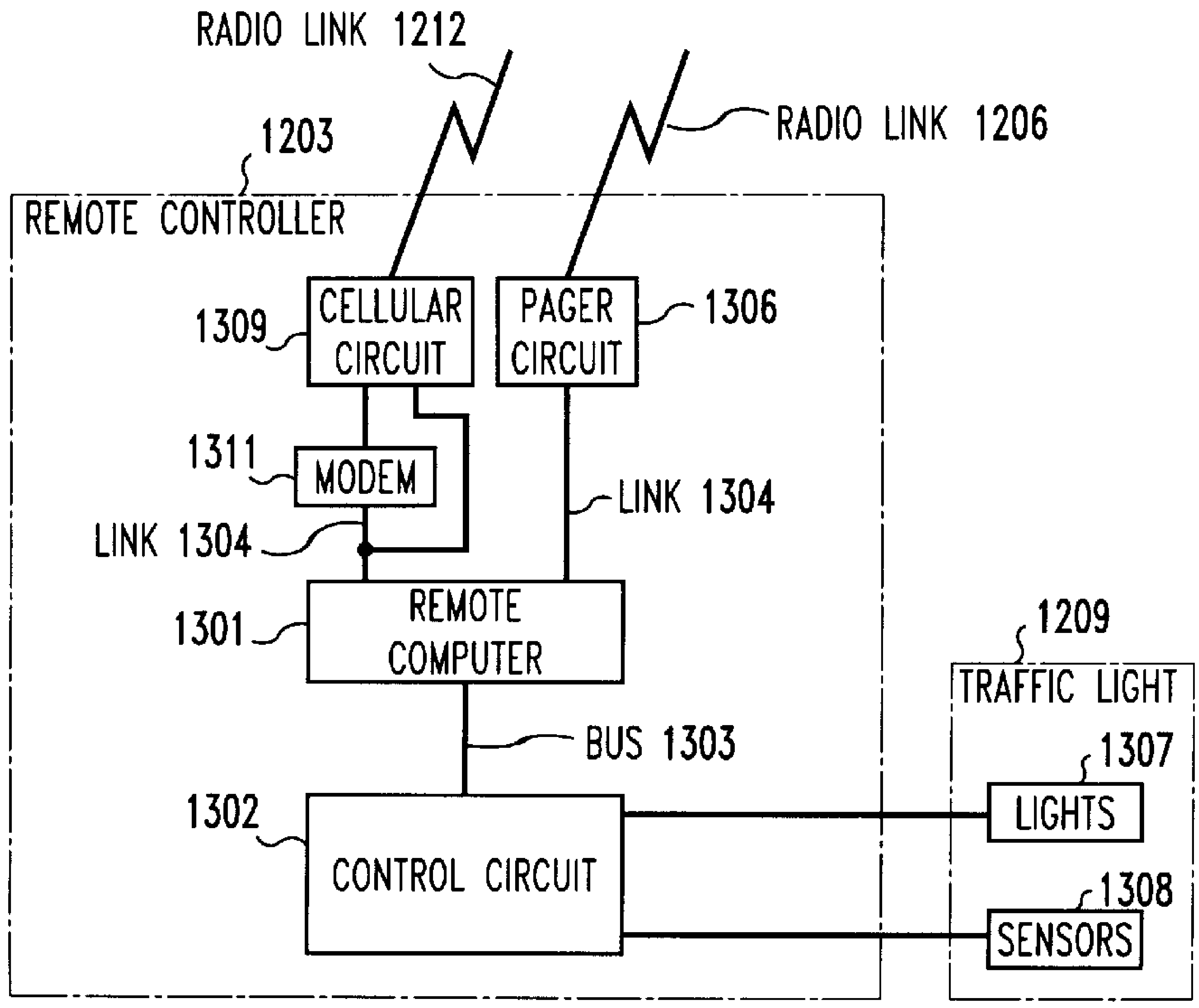
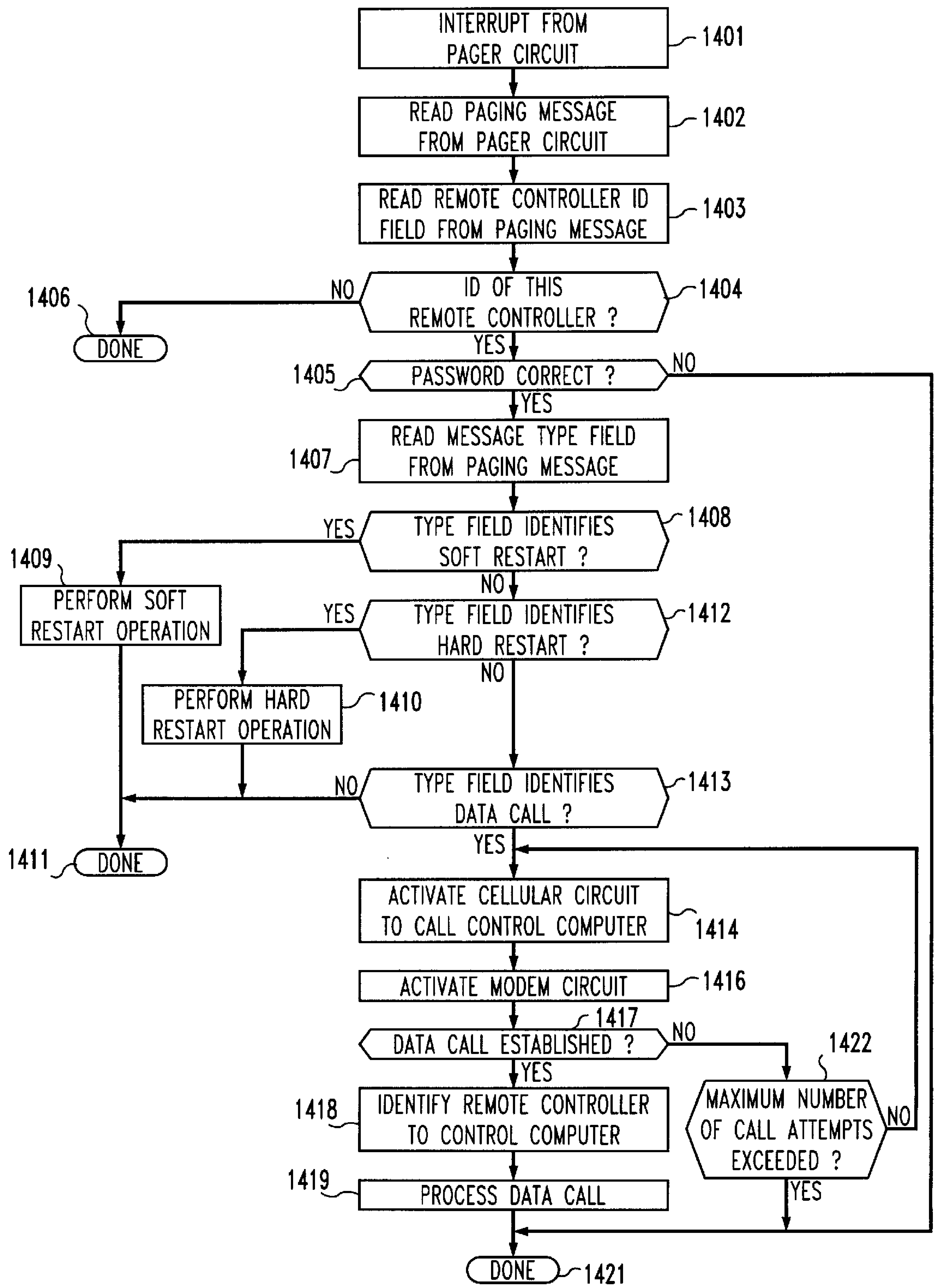

RADIO LINK 1212
RADIO LINK 1206
1203
REMOTE CONTROLLER
1309
CELLULAR CIRCUIT
PAGER CIRCUIT
1306
1311
MODEM
LINK 1304
LINK 1304
1301
REMOTE COMPUTER
1209
TRAFFIC LIGHT
BUS 1303
1307
1302
LIGHTS
CONTROL CIRCUIT
1308
SENSORS

FIG. 14


INTERRUPT FROM PAGER CIRCUIT
1401
READ PAGING MESSAGE FROM PAGER CIRCUIT
1402
READ REMOTE CONTROLLER ID FIELD FROM PAGING MESSAGE
1403
ID OF THIS REMOTE CONTROLLER ?
1404
NO
1406
DONE
YES
PASSWORD CORRECT ?
1405
NO
YES
READ MESSAGE TYPE FIELD FROM PAGING MESSAGE
1407
TYPE FIELD IDENTIFIES SOFT RESTART ?
1408
YES
1409
PERFORM SOFT RESTART OPERATION
NO
TYPE FIELD IDENTIFIES HARD RESTART ?
1412
YES
PERFORM HARD RESTART OPERATION
1410
NO
TYPE FIELD IDENTIFIES DATA CALL ?
1413
NO
1411
DONE
YES
ACTIVATE CELLULAR CIRCUIT TO CALL CONTROL COMPUTER
1414
ACTIVATE MODEM CIRCUIT
1416
1417
DATA CALL ESTABLISHED ?
NO
1422
YES
IDENTIFY REMOTE CONTROLLER TO CONTROL COMPUTER
1418
MAXIMUM NUMBER OF CALL ATTEMPTS EXCEEDED ?
NO
YES
PROCESS DATA CALL
1419
DONE
1421

MAINTENANCE AND ADMINISTRATION OF REMOTE SYSTEMS VIA RADIO PAGER

TECHNICAL FIELD

The invention relates generally to the administration and maintenance of remote computer systems, and specifically to the maintenance and administration of remote wireless telecommunications systems.

BACKGROUND OF THE INVENTION

In personal communication systems, PCS, there are a number of base stations each having the capacity to handle the telephone conversations from two to four PCS wireless handsets at a time. These base stations are connected to local and remote switches which are controlled by a central processor. The remote switches may be co-located with the central processor or may be interconnected to the central processor via the public network. The central processor directly controls the local switch. Each remote switch is controlled by a remote processor. In general, all maintenance and administration information is communicated to the remote processors via primary rate interface, PRI, links either directly or indirectly through the public network connected to the local switch and central processor. However, maintenance problems can occur in the remote switch that cannot be resolved by control information transmitted via the PRI links. In present PCS systems, there are only two options for resolving such maintenance problems. The first is to send a service technician to the site of the remote switch to manually perform the necessary restart operations. Another alternative is to have an independent telephone link to each remote switch from the central processor; whereby, the central processor can perform the restart operations via the independent telephone link.

The first solution suffers from the problems of high cost and inconvenience to users of the PCS wireless handsets while the remote switch is not functioning properly. The problem with the second solution is that in many countries it is difficult to get installation of telephone links. In addition, these telephone links are quite expensive. The expense becomes an important factor, since each remote switch may only handle a small number of base stations, and an individual base station can only provide service to two or four PCS handsets at any time.

This problem has not risen in cellular mobile telecommunications systems, since a base station in a cellular mobile telecommunications systems handles a large number of wireless handsets. The cost of providing an independent telephone link to a cellular mobile base station is insignificant in light of the high equipment costs of such a base station.

What is lacking in the prior art is a cost effective method for providing administration maintenance of remote systems.

SUMMARY OF THE INVENTION

This invention is directed to solving these and other shortcomings and disadvantages of the prior art. Illustratively according to the invention, each remote switch has an integral radio pager which is responsive to a commercial paging service; however, all pagers in the remote switches share the same paging service identification number. When a central processor that is controlling the operation of all remote switches performs a maintenance restart operation with respect to one of the remote switches, the central processor requests that the public paging service page the common service number. The central processor also provides the paging service a paging message that defines which remote switch is to respond to the page. Each integral pager is responsive to the page to interrupt an associated remote processor. In turn, each remote processor is responsive to the pager to examine the paging message and only responds if the remote processor finds its own identification number in the paging message. In addition, by utilizing the paging message, the central processor can perform a number of levels of maintenance restarts by the remote processor.

A second embodiment of the invention includes an integral cellular telephone circuit in each of the remote switches. Advantageously, these integral cellular telephone circuits share a common telephone number thereby reducing the cost of providing the cellular telephone circuit to the cost of the circuit itself for all practical purposes. In the second embodiment, when the central processor wants to establish a data communication link with the remote switch via a cellular telephone call, the central processor requests that the public paging service page the common service number and provides a paging message to the public paging service. The paging message defines the identification number of the remote switch that is to respond to the page. The remote processor is responsive to the paging message to set up a call via the integral cellular circuit to the central processor. Once the call is set up, the central processor and remote processor will then establish a data link overwhich communication takes place. The establishment of a data link allows the central processor to obtain data from the remote processor to more completely diagnose the state of the remote switch.

These and other advantages and features of the invention will become more apparent from the following description of an illustrative embodiment of the invention taken together with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** illustrates, in block diagram form, a wireless telecommunications system that incorporates an illustrative embodiment of the invention;

FIG. **2** illustrates, in block diagram form, the details of a remote switch;

FIG. **3** illustrates the format of the paging message transmitted by the paging service;

FIG. **4** illustrates, in flow chart form, the maintenance routine that is executed by a remote angel processor;

FIG. **5** illustrates, in block diagram form, a telecommunication system that incorporates a second embodiment of the invention;

FIG. **6** illustrates, in block diagram form, the details of a remote switch for use with the second embodiment of the invention;

FIG. **7** illustrates, in flow chart form, the maintenance routine executed by a remote angel processor in the second embodiment;

FIG. **8** illustrates, in flow chart form, the operations of a maintenance application in a node processor for the second embodiment;

FIG. **9** illustrates, in block diagram form, a traffic light control system that incorporates the first embodiment of the invention;

FIG. **10** illustrates, in block diagram form, the details of a remote controller;

FIG. **11** illustrates, in flow chart form, the operations performed by a maintenance routine executed in a remore computer;

FIG. 12 illustrates, in block diagram form, a traffic light control system that incorporates the second embodiment of the invention;

FIG. 13 illustrates, in block diagram form, the details of a traffic controller of FIG. 12; and

FIG. 14 illustrates, in flow chart form, a program executed in a remote computer of FIG. 13.

DETAILED DESCRIPTION

Switch node **100** provides overall control for a PCS system comprising a plurality of switches and base stations. Local switch **102** controls the operations of base stations **103–104**, remote switch **107** controls the operations of base stations **108–109**, and remote switch **121** controls the operation of base stations **122–123**. Node processor **101** provides overall call control, maintenance, and administration of the local and remote switches and associated base stations. Local switch **102** is directly controlled by node processor **102**. Remote switches **107–121** are controlled by node processor **101** via public network **106**. The control of remote switches in this manner is described in detail in U.S. Pat. No. 5,182,750 which is hereby incorporated by reference. That patent also sets forth the manner in which node processor **101** controls the operations of the local switch. Greater details on the configuration of a remote switch such as remote switch **107** are set forth in U.S. Pat. No. 5,386,466 which is hereby incorporated by reference.

During normal operations, for example, node processor communicates maintenance and administration information to remote switch **107**, utilizing PRI link **112**, public network **106**, and PRI link **113**. However, if remote switch **107** enters a failure state whereby node processor **101** can not communicate with remote switch **107** over this normal path, node processor **101** establishes a call via local switch **102**, PRI link **112**, and public network **106** to paging service **105**. Node processor **101** provides the common paging service number utilized by remote switches **107–121** along with a paging message. The paging message identifies remote switch **107** and the type of maintenance restart operation that is to be performed. Paging service **105** then transmits the paging service number and paging message via radio links **110** and **128**. All integral pagers respond to the page; however, only the remote angel processor circuit within remote switch **107** responds to the paging message. In response to the page message, remote switch performs the level of restart operation specified in the paging message. Since the same paging service number is utilized by all the remote switches, the cost of providing this maintenance operation via paging service **105** is largely limited to the cost of the integral paging circuit within each remote switch.

FIG. 2 illustrates the details of remote switch **107**. As described in U.S. Pat. No. 5,182,750, node processor **101** normally communicates with remote angel processor **201** via PRI link **113** and remote network **202**. Remote network **202** not only includes a switching fabric but also interface cards for terminating PRI links and BRI links. Greater details of the individual components of remote angel processor **201** and remote network **202** are given in U.S. Pat. No. 5,386,466. However, remote angel processor **201** and remote network **202** can enter certain failure states in which node processor **101** cannot by communicating over PRI link **113** force remote angel processor **201** and remote network **202** out of these particular failure states. Further, the action taken for one failure state is often different from the action required for another failure state.

When remote angel processor **201** and remote network **202** are in such failure states, node processor **101** requests that a paging message be sent by paging service **105** to all of the remote switches. The format of this message is illustrated in FIG. **3**. When this message is transmitted, pager circuit **206** is responsive to the paging service number to transmit a signal via link **204** to remote angel processor **201**. That signal causes a hardware interrupt in remote angel processor **101** forcing remote angel processor **201** into a maintenance routine. The maintenance routine then reads the paging message from pager circuit **206** via link **204** and examines the paging message. If processor **201** finds the remote switch ID for remote switch **107** in the Remote Switch ID field of the message, processor **201** continues to process the paging message.

The maintenance program executing in remote angel processor **201** examines the Message Type field for the restart code and Message Opcode field to determine the type of restart that should be performed. There are two basic types of restart. A soft restart preserves all calls currently set up but drops all calls that are in the process of being set up. A hard reset performs a hardware reset of remote angel processor **201** and forces all of the PRI and BRI interfaces to an idle condition. A hard reset drops all calls and loses the information in call records. A maintenance application program executing a node processor **101** first tries to restart remote angel processor **201** with a soft restart. If the soft restart does not allow the maintenance application to establish communication with remote angel processor **201** via a PRI link, the maintenance application requests that the hard reset be performed on remote angel processor **201** and remote network **202**.

FIG. **4** illustrates in detail the operations performed by the maintenance routine in a remote angel processor in responding to a paging message from paging service **105**. Block **401** is responsive to the interrupt from the pager circuit to transfer control to block **402**. The latter block reads the paging message from the pager circuit. Block **403** then reads the remote switch identification field from the paging message. Next, decision block **404** determines if the remote switch identification is that of the switch executing the maintenance routine. If the answer is no, control is transferred to block **406** which terminates operations with respect to the paging message. If the answer is yes in decision block **404**, decision block **405** determines if the password in field **302** is correct. If the answer is no, control is transferred to block **413**. If the answer is yes in decision block **405**, block **407** reads the information in message type field **303**, and decision block **408** determines if the type field identifies a soft restart. If the answer is yes in decision block **408**, control is transferred to block **409** which performs a soft restart operation. If the answer is no in decision block **408**, control is transferred to decision block **412** which determines if the type field identifies a hard restart. If the answer is yes, block **414** performs a hard restart operation before transferring control to block **411**. If the answer in decision block **412** is no, processing is complete and control is transferred to block **413**.

FIG. **5** illustrates a second embodiment of the invention. In FIG. **5**, switches **502**, **507**, and **521** are controlling a plurality of base stations **503–504**, **508–509**, and **522–523**. Node processor **501** controls remote switches **507** and **521** via public network **506**. When node processor **501** determines that a remote switch, such as remote switch **507** is in a state in which the remote switch cannot respond to node processor **501**, node processor **501** requests that a paging message be transmitted by paging service **505**. The Remote Switch ID field **301** of this paging message specifies remote switch **507**. Upon receiving the paging message, remote switch **507** places a cellular call to node processor **501** via cellular service provider **510**. In order to reduce the cost of providing the remote switches with cellular telephone capability, all remote switches share a single cellular telephone number. A remote switch will not try to place a cellular call unless requested to do so by node processor **501** via information in a paging message. Node processor **501** cannot place a cellular telephone call to the remote switches since the cellular circuit within a remote do not respond to incoming telephone calls.

FIG. **6** illustrates in greater detail the internal construction of remote switch **507**. When node processor **501** requests the transmission of a paging message that contains the identification code for remote switch **507**, pager circuit **606** of FIG. **6** is responsive to this message to transmit an interrupt to remote angel processor **601**. Remote angel processor **601** is responsive to the interrupt to determine from Remote Switch Identification field **301** that the message is for remote switch **107** and to execute a maintenance routine. The maintenance routine is responsive to the message type indicating a data call in the paging message to control cellular circuit **609** to place a cellular telephone call via cellular service **510** and public network **506** to node processor **501**. Local switch **502** of FIG. **5** utilizes an internal modem to answer this call and to convert the modem signalling into messages that can be transferred to node processor **501** via bus **511**. Once the telephone call is answered by a modem in local switch **502**, modem **611** of FIG. **6** establishes the initial modem protocol signalling. After the data call is established between node processor **501** and remote angel processor **601**, the maintenance application in node processor **501** request the transmission from the maintenance routine of remote angel processor **601** of data stored in remote angel processor **601**. Utilizing this data, node processor **501** can further analyze the recovery strategy that should be utilized to bring remote switch **507** back into service.

FIG. **7** illustrates, in flow chart form, the operations performed by a remote maintenance routine executing in a remote angel processor in one of the remote switches illustrated in FIG. **5**. Block **701** is responsive to an interrupt from the pager circuit to transfer control to block **702**. The latter block reads the paging message from the pager circuit and transfers control to block **703**. Block **703** reads the information in the remote switch ID number field **301**. Decision block **704** determines if the identification number is that of the present remote switch that is executing the maintenance program. If the answer is no, control is transferred to block **706** and processing is terminated. If the answer is yes in decision block **704**, control is transferred to decision block **705** which determines if the password in password field **302** is correct. If the answer is no, processing is terminated by transferring control to block **721**. If the answer is yes in decision block **705**, control is transferred to block **707**.

Block **707** reads the contents of message type field **303** from the paging message. Decision block **708** determines if the type field identifies a soft restart. If the answer is yes, control is transferred to block **709** which performs the soft restart operation before terminating processing by transferring control to block **711**. Returning to decision block **708**, if the answer is no, decision block **712** determines if the type field identifies a hard start. If the answer is yes, control is transferred to block **715** which performs the hard restart operation and then, transfers control to block **711**. If the answer is no in decision block **712**, control is transferred to decision block **713** which determines if the type field identifies a data call. If the answer is no in decision block **713**, processing is terminated by transferring control to block **711**. If the answer is yes in decision block **713**, control is transferred to block **714**.

Block **714** activates the cellular circuit to place a call to node processor **501**. After the call has been placed, block **716** activates the modem circuit to establish a data call with the modem connected to local switch **502**. Decision block **717** determines if a data call has been established. If the answer is no, decision block **722** determines if the maximum number of call attempts has been exceeded. If the answer in **722** is no, control is transferred back to block **714** to attempt to set up a call to node processor **501**. If the answer in decision block **722** is yes, processing is terminated by transferring control to block **721**. Returning to decision block **717**, if a data call has been established, control is transferred to block **718** which transmits identification information to the maintenance routine handling the data call in node processor **501**. Block **719** is then executed to process the data call.

FIG. **8** illustrates, in flow chart form, the operations performed by the maintenance application executing in node processor **501**. When the maintenance routine determines that it is necessary to establish a cellular data call with a remote switch, block **801** is executed to form the paging message for the specified remote switch. Block **802** then places a telephone call to paging service **505**, and block **803** identifies the paging service number utilized by all remote switches to paging service **505**. Then, block **804** transmits the paging message to paging service **505**. Control is then transferred to decision block **806** which determines when a cellular telephone call is received directed to the maintenance application in node processor **501**. If a cellular telephone call is received which is not from the cellular telephone number shared by the remote switches, control is transferred to block **807** which processes the call and then returns control back to decision block **806**. When a cellular telephone call is received from the cellular telephone number shared by the remote switches, decision block **808** is responsive to the identification information transmitted by the remote switch in block **718** of FIG. **7** to determine if that is the remote switch with which the maintenance application wishes to establish a data call.

If the answer is no in decision block **808**, block **809** drops the cellular telephone call and returns control back to block **801**. Block **801** attempts to once again establish the data call. If the answer in decision block **808** is yes, block **811** sets up the data call with the specified remote switch, and block **812** processes the data call.

FIG. **9** illustrates another application of the first embodiment. Remote controllers **903** through **904** are controlling traffic lights **909** through **911**. As illustrated in FIG. **10**, remote controller **903** is responsive to sensors **1008** to properly control lights **1007**. Control circuit **1002** is under control of remote computer **1001**. Remote computer **1001** contains the necessary algorithms to process information from sensors **1008** to proper control lights **1007**. Remote computer **1001** is a stand alone unit and under normal operating conditions functions without outside help. From time to time, it is necessary to change the algorithms utilized by remote computer **1001**. Control computer **901** of FIG. **9** does this by sending a paging message via paging service provider **902** to remote controller **903**. Remote controllers **903** through **904** share a common paging service number. Paging circuit **1006** is responsive to the paging message from control computer **901** to transmit an interrupt to remote computer **1001**. In response to the interrupt, remote computer **1001** identifies the identification code for remote controller **903** within the paging message. Message type field **303** of the paging message defines that the paging message is a data message and Message Length field **306** defines the number of bytes of the data message. Message field **307** of the paging message contains information to update the algorithms utilized by remote computer **1001**. Note, that a number of paging messages may be required to transfer the necessary algorithmic information to remote computer **1001**. The interaction between remote computer **1001** and pager circuit **1006** was described in greater detail with respect to pager circuit **206** and remote angel processor **201** of FIG. **2**.

The second function for which control computer **901** utilizes the paging link into the remote controllers is to synchronize a group of traffic lights. When message type field **303** of the paging message indicates a synchronization operation, message opcode field **304** contains the group identification number for the group that is to perform the synchronization operation. In addition, message field **307** contains the time of day that the remote computers are to reset their internal timers to. A group would consist of a series of traffic lights controlling the flow of traffic on one street. Each remote computer has an internal timer for maintaining the time of day. However, over a period of time, these timers drift, and the time of day in each remote computer will be different. To correct this problem, control computer **901** sends out a message identifying a particular group of remote controllers. In addition, this message defines that the remote computers are to reset their internal clocks to a particular time of day. When the paging message is received, paging circuit **1006** immediately interrupts remote computer **1001**. All remote computers then adjust their internal clocks at approximately the same time. The time variance is within the allowable amount that traffic lights can be out of synchronization with each other. The amount of time that paging service provider **902** takes in actually transmitting the paging message varies; however, all remote controllers receive this message at the same time. It is not critical that the remote computers have the exact time of day but rather that they be in synchronization with each other.

A third use that control computer **901** makes of the radio links is to restart an individual remote controller. When the operator of computer **901** receives a report that a traffic light is malfunctioning, the operator requests that control computer **901** restart the malfunctioning remote controller. The paging message that is transmitted by control computer **901** via paging service provider **902** addresses an individual remote controller and specifies that the remote controller is to perform a hard restart. After the remote computer within the remote controller has performed a hard reset, control computer **901** then transmits the group ID with the time-of-day information so as to bring all the remote controllers within a given group into time synchronization with each other.

FIG. **11** illustrates, in flow chart form, the operations performed by a maintenance routine in a remote switch of FIG. **9**. Block **1101** is responsive to an interrupt from the pager circuit to transfer control to block **1102**. The latter block reads the paging message from the pager circuit and transfers control to block **1103**. Block **1103** reads the remote controller identification field which is equivalent to field **301** of FIG. **3**. Decision block **1104** then determines if the identification number is that of the remote controller executing the maintenance routine. If the answer is yes, control is transferred to decision block **1105** which determines if the password in field **302** is correct. If the answer is no in decision block **1105**, processing is terminated by transferring control to block **1119**. If the answer in decision block **1105** is yes, block **1107** reads the message type field from the paging message. Next, decision block **1108** determines if the type field identifies a soft restart. If the answer is yes, block **1109** performs a soft restart operation before terminating processing by transferring control to block **1119**. If the answer in decision block **1108** is no, decision block **1112** determines if the type field in the equivalent of field **303** identifies a hard restart. If the answer is yes, block **1111** performs the hard restart operation before terminating processing by transferring control to block **1119**. If the answer in decision block **1112** is no, decision block **1113** determines if the type field identifies a data message. If the answer is yes, block **1110** processes the data message in message field **307** utilizing the message length field **306**. If decision block **1113** determines that there is not a data message to process, processing is terminated by transferring control to block **1119**.

If the answer in decision block **1104** is that the remote controller's identification number is not in field **301** of the paging message, control is transferred to block **1106**. The latter block reads the group identification field from the paging message. In FIG. **3**, the group identification field takes the place of message opcode field **304**. Decision block **1114** determines if the number in the group identification field is that of the present remote controller. If the answer is no, processing ceases. If the answer is yes, block **1116** reads message type field **303** from the paging message and determines if the type field identifies the synchronization operation by execution of decision block **1117**. If the answer is yes in decision block **1117**, block **1118** sets the internal clock equal to the contents of the message field before transferring control to block **1119**. If the answer in decision block **1117** is no, processing is terminated by passing control to block **1119**.

FIGS. **12** and **13** illustrate the utilization of the second embodiment of the invention with respect to remote controllers controlling traffic lights. Each remote controller, such as remote controller **1203**, as illustrated in FIG. **13**, has a cellular circuit from which the remote controller can place outgoing calls. All the cellular circuits in the remote controllers share a common telephone number. During administration or the resetting of a remote controller, control computer **1201** transmits a paging message via paging service provider **1202** to an individual remote controller. The paging message requests that the remote computer within the remote controller place a call to control computer **1201**. For example, after a data link has been established between control computer **1201** and remote computer **1301** of FIG. **13**, control computer **1201** can read the necessary data from computer **1301** and determine the best way to do a restart operation and also whether it is necessary to send a service technician to the site of remote controller **1203**. During administration, the data link established between remote computer **1301** and control computer **1201** allows control computer **1201** not only to transfer administration information at a higher rate to remote computer **1301** but also to verify that the information was received by remote computer **1301**.

FIG. **14** illustrates, in flow chart form, the program executed in a remote computer of a remote controller of FIG. **12** in responding to a paging message transmitted by control computer **1201** via paging service **1202**. Block **1401** is responsive to an interrupt from the pager circuit to transfer control to block **1402** which reads the paging message from the pager circuit. Block **1403** reads the remote controller ID field which is equivalent to field **301** from the paging message, and decision block **1404** determines if the remote controller ID is the ID of the present remote controller. If the answer is no, processing is terminated by execution of block **1406**. If the answer is yes, decision block **1405** determines if the password in password field **302** is correct. If the answer is no, further processing is terminated by transferring control to block **1421**. If the answer in decision block **1405** is yes, block **1407** reads the message type from message type field **303** and control is passed to **1408**. Decision block **1408** determines if the type field identifies a soft restart. If the answer is yes, block **1409** performs a soft restart operation before terminating processing by transferring control to block **1411**. If the answer in decision block **1408** is no, decision block **1412** determines if the type field identifies a hard restart. If the answer is yes, block **1410** performs a hard restart operation and then transfers control to block **1411**. If the answer in decision block **1412** is no, decision block **1413** determines if the type field identifies a data call operation. If the answer is no, processing is terminated by transferring control to block **1411**. If the answer in decision block **1413** is yes, control is transferred to block **1414**.

Block **1414** activates the cellular circuit to make a cellular call to control computer **1201**. Block **1416** activates the modem circuit on the call being set up so as to establish a data call when the call is answered by a modem connected to control computer **1201**. Decision block **1417** determines when the data call has been established. If a data call has not been established, decision block **1422** determines if the maximum number of call attempts exceeds a predefined value. If the answer is no, control is transferred back to block **1414**. If the answer in decision block **1422** is yes, processing is terminated by transferring control to block **1421**. If the answer in decision block **1417** is that a data call has been established, block **1418** transmits the identity of the remote controller to control computer **1201**. Block **1419** then processes the data call.

It is to be understood that the above-described embodiments are merely illustrative of the principles of the invention and that other arrangements may be devised for those skilled in the art without departing from the spirit and scope of the invention. In particular, one skilled in the art could readily envision other applications of the embodiments in addition to remote wireless switches or traffic lights.

The invention claimed is:

1. A method of communicating information with remote units and each remote units having a remote processor, pager circuit, and a wireless circuit, the method comprising the steps of:

assembling a paging message comprising an identification number of one of the remote units by a central computer;

transmitting a paging identification number of the remote units and the paging message by the central computer via a paging system whereby the paging identification number is common to all of the remote units;

receiving the paging identification number and the paging message by the pager circuits in the remote units;

communicating the paging message to the remote processors controlling the remote units by the pager circuits; and

establishing a wireless data telephone call via a wireless switching system to the central computer by one of the remote processors controlling the one of the remote units using the wireless telephone circuit in the one of the remote units upon the one of the remote processors recognizing the identification number of the one of the remote units wherein all of the wireless telephone circuits share one wireless telephone number and only a single one of all of the wireless telephone circuits in all of the remote units can place and be active on a wireless telephone call at any time.

2. The method of claim **1** further comprises the step of exchanging information by the one of the remote processors and central computer via the wireless data telephone call.

3. The method of claim **2** wherein the step of exchanging comprises transferring time of day information from the central computer to the one of the remote processors.

4. A method of communicating information with remote switches and each remote switches having a remote processor, pager circuit, and wireless telephone circuit and providing wireless service for wireless telephones via a plurality of base stations, and a switch node having a switching network and a node processor for controlling the switch node, and the remote switches interconnect to the switch node by telephone s the method comprising the steps of:

assembling a paging message comprising an identification number of one of the remote switches by a node processor;

transmitting a paging identification number of the remote switches and the paging message by the node processor via a paging system whereby the paging identification number is common to all of the remote switches;

receiving the paging identification number and the paging message by the pager circuits in the remote switches;

communicating the paging message to the remote processors controlling the remote switches by the pager circuits; and

establishing a wireless data telephone call to the node processor via a wireless switching system and the switching network of the switch node by one of the remote processors controlling the one of the remote switches using the wireless telephone circuit in the one of the remote switches upon the one of the remote processors recognizing the identification number of the one of the remote switches wherein all of the wireless telephone circuits share one wireless telephone number and only a single one of all of the wireless telephone circuits can place and be active on a wireless telephone call at any time.

5. The method of claim **4** further comprises the step of exchanging information by the one of the remote processors and node processor via the wireless data telephone call.

6. The method of claim **5** wherein the step of exchanging comprises transferring administration information from the node processor to the one of the remote processors.

7. The method of claim **5** wherein the step of exchanging comprises transferring maintenance information from the one of the remote processors to the node processor.

8. The method of claim **7** further comprises the steps of determining by the node processor a type of initialization that should be performed by the one of the remote processors;

transmitting the type of initialization to the one of the remote processors by the node processor via the wireless data telephone call; and

performing the type of initialization by the one of the remote processors.

9. An apparatus for receiving information by remote units and each remote units having a remote processor, pager circuit, and wireless telephone circuit, comprising:

a central computer transmitting a paging identification number of the remote units and a paging message via a paging system to the remote units whereby the paging identification number is common to all of the remote units;

the pager circuits in the remote units receiving the paging identification number and the paging message wherein the paging message having an identification number of one of the remote units;

the pager circuits further communicating the paging message to the remote processors controlling the remote units in response to the paging identification number which common to all remote units; and

one of the remote processors controlling the one of the remote units using the wireless telephone circuit in the one of the remote units for establishing a wireless data telephone call via a wireless switching system to the central computer upon the one of the remote processors recognizing the identification number of the one of the remote units wherein all of the wireless telephone circuits share one wireless telephone number and only a single one of all of the wireless telephone circuits can place and be active on a wireless telephone call at any time.

10. The apparatus of claim **9** further comprises the one of the remote processors and central computer exchanging information via the wireless data telephone call.

11. The apparatus of claim **10** wherein the exchanging comprises transferring time of day information from the central computer to the one of the remote processors.

12. An apparatus for communicating information with remote switches and each remote switches having a remote processor, pager circuit, and wireless telephone circuit and providing wireless service for wireless telephones via a plurality of base stations, and a switch node having a switching network and a node processor for controlling the switch node, and the remote switches interconnect to the switch node by telephone links, comprising:

the node processor assembling a paging message comprising an identification number of one of the remote switches;

the node processor further transmitting a paging identification number of the remote switches and the paging message via a paging system whereby the paging identification number is common to all of the remote switches;

the pager circuits in the remote switches receiving the paging identification number and the paging message;

the pager circuits further communicating the paging message to the remote processors controlling the remote switches; and

one of the remote processors controlling the one of the remote switches establishing a wireless data telephone call to the node processor via a wireless switching system and the switching network of the switch node using the wireless telephone circuit in the one of the remote switches upon the one of the remote processors recognizing the identification number of the one of the remote switches wherein all of the wireless telephone circuits share one wireless telephone number and only a single one of all of the wireless telephone circuits can place and be active on a wireless telephone call at any time.

13. The apparatus of claim **12** further the one of the remote processors and node processor exchanging information via the wireless data telephone call.

14. The apparatus of claim **13** wherein the exchanging comprises transferring administration information from the node processor to the one of the remote processors.

15. The apparatus of claim **13** wherein the exchanging comprises transferring maintenance information from the one of the remote processors to the node processor.

16. The apparatus of claim **15** further the node processor determining a type of initialization that should be performed by the one of the remote processors;

the node processor further transmitting the type of initialization to the one of the remote processors via the wireless data telephone call; and

the one of the remote processors further performing the type of initialization.

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